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ABSTRACT

The objective of this study of California projects, funded under Title I of the 1965 Elementary Secondary Education Act, was to shed additional light on the cost-benefit and "critical mass" issues which are central to today's compensatory education planning and policy making. It covers reading and math programs in grades one through twelve. The study sample included all schools in California which reported both achievement gains and expenditures. The data analysis utilized statistical controls such as the removal of the effects of regular per-pupil expenditures when the impact of supplementary expenditures was assessed. Saturated schools--those with 75 percent or more of the pupils eligible for Title I participation--were found to differ significantly from unsaturated schools with the latter showing greater gains in both reading and math and greater Title I per-pupil expenditures. Within the unsaturated schools, however, there was no relationship between achievement gains in either reading or math and any combination of regular and supplementary expenditures. In saturated schools, a significant relationship was found between achievement gains and Title I per-pupil expenditures for reading but not for math. The expenditure differences accounted for about ten percent of the variation in achievement. (Author/JM)

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FINAL REPORT

Contract No. OEC-0-72-5179

AN ANALYSIS OF THE RELATIONSHIP BETWEEN READING AND MATHEMATICS ACHIEVEMENT GAINS AND PER-PUPIL EXPENDITURES IN CALIFORNIA TITLE I PROJECTS, FISCAL YEAR 1972

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in the Behavioral Sciences
Palo Alto, California

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EXECUTIVE SUMMARY

The objective of the present study was to shed additional light on the cost-benefit and "critical mass" issues which are central to today's compensatory education planning and policy making. Because it depended entirely on existing data made available by the California State Department of Education, the study is subject to many of the shortcomings of its predecessors. Its scope, however, is somewhat more comprehensive (reading and math programs in grades 1 through 12), its sampling somewhat more representative (all schools in the state which reported both achievement gains and expenditures), and its statistical controls somewhat more adequate (the effects of regular per-pupil expenditures were statistically removed when the impact of supplementary expenditures was assessed) than has been typical of studies in this field.

Saturated schools (those with 75% or more of the pupils eligible for Title I participation) were found to differ significantly from unsaturated schools with the latter showing greater gains in both reading and math and greater Title I per-pupil expenditures. Within the unsaturated schools, however, there was no relationship between achievement gains in either reading or math and any combination of regular and supplementary expenditures. In saturated schools, a significant relationship was found between achievement gains and Title I per-pupil expenditures for reading but not for math. The expenditure differences accounted for about 10% of the variation in achievement.

Achievement gains were generally greater than month for month at all grade levels and averaged 1.4 months per month for both reading and math in unsaturated schools. This finding, however, was inconsistent with the fact that grade-equivalent status at the time of pretesting was consistently below the so-called disadvantaged norm of .7 months per month. At the end of sixth grade, performance was at the beginning fifth grade level -- almost exactly the normal expectation for disadvantaged children. This finding suggests either that children tend

not to continue in Title I projects from year to year or that accelerated school-year learning is matched by accelerated losses over the summer.

No evidence could be found suggesting the existence of any kind of critical mass. For the most part, there was no relationship between expenditures and gains. Where such relationships did exist, they appeared to be consistent over the entire ranges of gains and expenditures.

It was pointed out that the deficiencies known to exist in the data would tend to attenuate or obscure whatever real relationships might exist. This would imply that the true cost-benefit relationship might be somewhat stronger than that which was observed. There was no indication, however, that better data would uncover a critical mass.

Some evidence was found that supplementary per-pupil expenditures are not proportional to the educational needs of pupils. For math projects in saturated schools, a significant negative relationship was found.

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INTRODUCTION

A leading consumer organization advertises its monthly product evaluation publication with the question, "Would you pay $480.00 for a color T.V. set if you could get better performance for $80.00 less?" -- implying that there are major qualitative differences among products which are independent of price. The old saw, "You get what you pay for", represents the other side of the coin.

Compensatory education, as a consumer product, has been the subject of a similar difference of opinion, and both sides cite empirical evidance (sometimes without appropriate scientific detachment) to support their stand (Welsh, 1972). Proponents of the existence of a relationship between expenditures and benefits in educational programs for the disadvantaged (DHEW, 1972) are able to quote a variety of studies which have found such a relationship. In all cases, as is pointed out by the other side however, there has been some question as to the reliability and/or validity of the data on which they were based.

Wargo, Tallmadge, Michaels, Lipe, and Morris (1972) were unable to find nationally representative data indicating that Title I had had any impact whatsoever on program participants -- to say nothing of finding a relationship between costs and benefits. Some successful state programs and a larger number of local projects were identified, but the preponderance of meaningful data at these levels failed to support the existence of a cost-effectiveness relationship. Despite the lack of empirical evidence, however, the authors concluded that "it seems likely that some positive relationship does exist [p. 193]."

Perhaps the most frequently cited relevant study (e.g., by President Nixon in his message to Congress concerning the Equal Educational Opportunities Act of 1972) is the so-called "California Follow-up," a cooperative, two-day analysis carried out by USOE's Bureau of Elementary and Secondary Education and the California Division of Compensatory Education using a sample of FY 69 Title I projects in California. This unpublished analysis started with cost and achievement data on 709

local Title I projects. From these projects, which did not include any from the state's ten largest school districts, a subsample of 71 was selected which included all projects with a primary emphasis on reading and which fell into one of the following three cognitive growth categories: (a) at least 2 months grade-equivalent gain per month of project exposure, (b) 1.5 to 1.9 months per month, and (c) less than 1 month per month of exposure (a fourth growth category, 1.0 to 1.4 months per month, was excluded from the analysis for reasons of economy).

The California Follow-up study showed a clear and rather strong* relationship between gains and per-pupil Title I expenditures. It acknowledged, however, that the sample of projects studied was not representative and that the findings were not generalizable to the state as a whole. Whether the sample of projects was representative or not, however, is less important than the two questions: (a) "Did costs and benefits covary?" (they did), and (b) "Were increased expenditures responsible for the covariation?" (alternative hypotheses may be tenable).

One alternative to the causal relationship between expenditures and gains is the hypothesis that the better learners within the Title I population receive larger per-pupil expenditures than the less able. This hypothesis has some plausibility since (a) the "formula" for determining Title I allocations is tied to regular per-pupil expenditures in such a way that schools with above-average regular expenditures will receive above-average Title I per-pupil funding and (b) such schools (in 1969, at least) were in above-average socioeconomic status areas. It has, of course, been found repeatedly that learning ability is related to the socioeconomic status of schools (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld, & York, 1966; Chalupsky, Danoff, Coles, Roberts, Rodabaugh, and Weisgerber, 1972).

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* A Chi Square analysis performed by the author of this report on a three-by-three contingency table representing the three cognitive growth categories and three levels of per-pupil expenditure (0 - $149, $150 - $249, and $250 - $649) was statistically significant at the .001 level.

Several other cost-effectiveness studies were conducted in the State of California. One, undertaken by the Office of the Los Angeles County Superintendent of Schools (1970) examined the impact of variations in funding on Title I reading projects for second and third grade children. This rather well-controlled study concluded that "there was little evidence of a relationship between cost and reading achievement [p. iv]." Kiesling (1971), on the other hand, found that the amount of instruction given by trained reading specialists was consistently related to achievement gains. In a later paper (1972), he estimated that the amount of such instruction which would be required to bring disadvantaged children from a learning "rate" of .7 months per month up to the national norm would cost approximately $300 per pupil.

Kiesling's research exemplifies an approach rarely taken in examining cost-benefit relationships. He began with the identification of an instructional process which "worked" and then related costs to varying amounts of treatment employing this process. It is far more common for research in this field to make the implicit assumption that the spending of money is, in itself, an instructional treatment.

It seems reasonable to assume that differences in spending effectiveness will occur from project to project. If it can be assumed that these differences are randomly distributed throughout the population of projects, they would act as "noise" in the system or, in statistical terminology, "error variance." They would attenuate but should not completely obscure whatever cost-effectiveness relationships exist.

There are other attenuating factors as well, including inadequate and unstandardized accounting practices, use of a variety of different achievement tests, and non-uniform testing intervals. Taken together these factors generate a substantial amount of random error.

In addition to the random influences, are variables which are known, or suspected, to vary systematically with either expenditure, or achievement, or both. These confounding variables need to be considered in study design because, unlike the random influences, they may generate specific biases -- not noise.

Systematic influences are not necessarily important where samples are large and representative since, under these conditions, they do not introduce bias. Even where this is the case, however, it is generally desirable to be able to assess the impact of such influences. This is particularly true where they function as moderator variables affecting relationships among other variables. The finding of Chalupsky et al. (1972) that the relationships of achievement with school, teacher, and pupil characteristics were significantly different for low socioeconomic status pupils than for high socioeconomic status pupils underscores the importance of this consideration. When socioeconomic status was not considered in this way, most other relationships tended to disappear.

The purpose of all this discussion is merely to point out that the cost benefit issue is a complex one. Many factors are at least potentially relevant and could act either so as to obscure real relationships or to introduce spurious relationships depending on how the sampling and other aspects of experimental design are handled.

To date there has been no adequate analysis of the relationship between cost and effectiveness in California or anywhere else. Nor does it seem likely that the issue will be adequately dealt with in the near future, as to do so would be an undertaking of vast proportions.

On the other hand, each study completed to date, if interpreted with full consideration of its strengths and weaknesses, expands our knowledge relative to this important issue. Each study, furthermore, suggests new ways of gathering additional information and addressing new aspects of the overall question.

The study reported herein aspires to no more. It is perhaps most nearly akin to the California Follow-up although its findings are not entirely compatible with those of that study. The differences, however, appear to be explainable in terms of differences in sampling and analytical procedures.

METHODOLOGY

The present study was designed to make use of existing data. Its undertaking was motivated by the ongoing controversy over the cost-effectiveness issue in compensatory education in the hope that additional relevant information could be compiled rapidly and inexpensively.

Any study of this type is seriously limited with respect to the scientific rigor which can be brought to bear on the issues. The exact nature of these limitations is discussed below and must be kept in mind when interpreting the study's findings.

The Data and their Limitations

The State of California collects, via questionnaire, substantial amounts of data each year regarding Title I projects from participating educational agencies. These data are supplied at the school level if schools are "saturated" -- that is, if 75% or more of their pupils are Title I eligible. Reporting is at the school-district level if schools are unsaturated.

Achievement data are collected by grade level separately for reading and mathematics and consist of (a) name of test, (b) form, (c) level, (d) months between pre- and posttest, (e) number of students receiving both pre- and posttests, (f) median pretest grade equivalent, (g) median posttest grade equivalent; (h) posttest minus pretest grade equivalent, (i) pretest mean scale score, (j) posttest mean scale score, and (k) posttest mean scale score minus pretest mean scale score. Because of the variety of tests used and the clear non-equivalence of scaled scores, the researcher interested in state-wide analyses has no choice but to rely on the median grade-equivalent data, even though the deficiencies of such scores have been well documented by Kiesling (1970) and others.

On the same questionnaire, schools (if saturated) or school districts (if unsaturated) provide estimates* of the (a) Title I, (b) Special

* School accounting procedures are such that, while Title I and other supplementary expenditures are usually well documented by project, they are not generally broken down by project component (reading, math, etc.).

Teacher Employment Program, (c) Miller-Unruh Basic Reading Act, (d) District Funds, and (e) other supplementary funds spent for reading and (separately) for math projects. The numbers of participants by grade level by target school are also called for on the questionnaire, but these data are of little use for studies of this type since costs are not similarly broken down.

The questionnaire incorporates no provision for reporting regular per-pupil expenditures. These data are, however, available in a separate document, California Public Schools, Selected Statistics, an annual publication of the State Department of Education. Unfortunately for the purposes of this study, while all other data were drawn from FY 72, regular per-pupil expenditure data had to be taken from FY 71 as the 1972 data had not been published at the time the analyses were undertaken.

Ideally, for an analysis of the type described herein, all data should be available on a per-pupil basis. Furthermore, achievement data should be collected using a single (within grade level) standardized instrument administered on the same dates statewide for both pre- and posttests. Standard scores should be employed.

Clearly none of these desirable conditions was met. At best, some achievement data were available by grade level within (saturated) schools. The remaining achievement data were by grade level within school district; but different tests were used, administered at different times and intervals, and with scores expressed in grade equivalents -- a practice particularly inappropriate for non-average students.

In the cost domain, the situation was still less desirable with no data available by grade level and only some (supplementary expenditures in saturated schools) available at the school level. Most cost data were available only at the district level.

All of these shortcomings in the existing data should have the effect of attenuating the evidence of whatever cost-benefit relationships may really exist. They should not produce any systematic biases resulting in the emergence of spurious relationships.

Perhaps the most severe of the shortcomings are those relating to the cost data. Even these, however, should not obscure any significant relationships which may exist if certain assumptions are valid. The lack of cost data by grade level, for example, is of no import if the analyses are conducted separately for each grade and if the pattern of per-pupil expenditure variation by grade level is similar from school to school. To establish correlational relationships between expenditures and gains it is not necessary to know the exact values of either -- only their relative values from one school to another.

This same argument applies to the fact that the regular per-pupil expenditure data used in this study were from FY 71 while all other data were from FY 72. As long as each district maintained nearly the same position relative to other districts on the per-pupil expenditure continuum both years, the consequences of this situation should be of little significance regardless of state-wide increases or decreases.

Procedures

A computer tape was purchased from the California State Department of Education which contained the following ESEA Title I evaluation data: (a) number of participants by grade level in reading and math projects, (b) reading test data by grade level (see above for description), (c) math test data by grade level, (d) supplementary per-pupil expenditure estimates for reading and math components broken down by funding source (Title I, Special Teacher Employment Program, etc.) and (e) coding information identifying school and/or districts and whether saturated or unsaturated. The tape presumably was a copy of that used by the State Department in preparing its annual Title I evaluation report but with data not directly related to the present study deleted.

In preparation for analysis, special data files were created which included the following ten variables in addition to identifying codes:

Variable	Description
1	Saturated - Unsaturated
2	Pretest Median Grade Equivalent
3	Posttest Median Grade Equivalent
4	Average Monthly Gain [(Var 3 - Var 2) : months between testing]
5	Number of Students with both Pre- and Posttests
6	Regular Per-pupil Expenditure (merged from keypunched cards)
7	Title I Per-pupil Expenditure (Title I expenditure : number of participants)
8	Title I plus Special Teacher Employment Program Per-pupil Expenditure (Title I + STEP expenditures : number of participants)
9	Total Supplementary Per-pupil Expenditure (Title I + STEP + Miller-Unruh + District + "other supplementary" expenditures : number of participants)
10	Total Per-pupil Expenditure (Var 6 + Var 9)

Means and standard deviations of these variables and their intercorrelations were computed using the BMD 02D program. This program was selected because it produces scatter diagrams of selected pairs of variables thereby providing immediate visual evidence regarding the "critical mass" issue.

Analyses were by grade level, separately for reading and math, and separately for saturated and unsaturated schools. Forty-eight sets of statistics (12 grade levels x 2 subject matters x 2 types of schools) were thus obtained. These statistics as well as additional analyses performed upon them are discussed in subsequent chapters.

RESULTS

As stated in the previous chapter, analyses were carried out in such a way that there were four main groups defined by subject matter (reading and math) and type of school (saturated and unsaturated). Within these four groups, separate analyses were conducted at each grade level yielding a total of 48 sets of statistics. Tables 1 through 4 present the mean achievement and cost figures for each of the 48 analyses. It should be noted that sample sizes are very small for grades 7 through 12 in saturated schools. The representativeness of achievement and cost means (for both reading and math) for these grade levels is clearly inadequate, and the values presented in the tables may be grossly different from state-wide averages.

Of interest in Tables 1 through 4 is the fact that nearly all of the achievement gains (at least where sample sizes are adequate) exceed month for month. At the same time, however, test results show that the discrepancies between grade levels and grade equivalent scores increase with increasing grade level. This apparent inconsistency is discussed in more detail later.

Also of note is the relationship between grade level and average monthly gain which is quite strong for reading projects in unsaturated schools ($r = .82$) and also substantial for math projects in unsaturated schools ($r = .59$) but which is not found in saturated schools ($r = .10$ for reading and $r = -.34$ for math). The cause of this phenomenon is not entirely clear. It should be noted, however, that the discrepancy between grade level and pretest grade equivalent is substantially greater (the pupils are farther behind grade level) in the unsaturated schools. Furthermore, the discrepancy is greater for unsaturated reading than for unsaturated math projects. Taken together these facts would tend to suggest that the observed relationships are due to operation of the so-called regression effect (cf. Gage, 1963). With the correlations based as they are on a small sample size (12 grade levels), however, and with the further complication that some of the data points are themselves suspect, overinterpretation of these findings is to be avoided.

TABLE 1

Achievement and Expenditure Means -- Reading Projects in Unsaturated Schools

Grade	Number of Districts	Pupils per District	Pretest	Posttest	Average Mo. Gain	Regular $ Per-pupil	Title I $ Per-pupil	Title I + STEP	Total $ Supplem.
1	204	127	9.8	17.1	1.07	772	204	205	249
2	316	123	14.3	23.5	1.29	787	197	198	250
3	321	123	19.8	30.2	1.43	787	198	199	251
4	312	122	26.4	36.8	1.46	786	200	201	254
5	298	125	33.5	43.4	1.38	782	201	202	249
6	277	123	38.9	49.3	1.41	782	199	201	248
7	49	123	43.1	55.3	1.73	809	229	230	292
8	46	122	47.0	58.8	1.81	789	234	235	271
9	77	127	54.0	66.5	1.74	933	231	231	303
10	61	125	59.9	71.8	1.62	944	242	243	285
11	51	128	61.8	76.6	1.93	937	238	239	326
12	36	131	62.0	74.1	1.60	930	217	217	249

TABLE 2

Achievement and Expenditure Means -- Reading Projects in Saturated Schools

Grade	Number of Districts	Pupils per District	Pretest	Posttest	Average Mo. Gain	Regular $ Per-pupil	Title I $ Per-pupil	Title I + STEP	Total $ Supplem.
1	44	117	10.4	17.7	1.02	832	140	155	172
2	169	116	16.1	23.8	.96	814	71	78	99
3	167	120	21.4	29.3	.99	814	72	79	100
4	161	116	29.0	36.6	1.07	815	73	80	101
5	166	116	35.1	42.1	.99	814	70	76	97
6	166	116	40.0	47.6	1.07	814	68	75	95
7	5	123	41.2	53.2	1.71	873	113	119	153
8	5	123	51.0	67.0	2.34	873	113	119	153
9	4	125	52.8	77.0	3.46	893	117	117	150
10	1	115	58.0	52.0	- .99	965	373	373	373
11	1	115	73.0	79.0	1.00	965	373	373	373
12	1	115	93.0	102.0	1.50	965	373	373	373

TABLE 3

Achievement and Expenditure Means -- Math Projects in Unsaturated Schools

Grade	Number of Districts	Pupils per District	Pretest	Posttest	Average Mo. Gain	Regular $ Per-pupil	Title I $ Per-pupil	Title I + STEP	Total $ Supplem.
1	194	530	10.3	17.9	1.13	779	146	146	148
2	281	524	15.8	25.6	1.36	785	151	152	157
3	292	525	22.2	33.0	1.50	784	153	153	159
4	289	523	30.0	40.8	1.51	778	161	162	167
5	278	522	36.9	47.0	1.41	776	161	162	170
6	267	501	41.8	51.2	1.31	779	158	159	167
7	46	526	46.7	57.1	1.46	800	164	164	199
8	40	515	52.1	61.4	1.31	793	144	144	164
9	65	525	57.2	69.6	1.69	933	154	154	175
10	46	537	60.5	71.0	1.43	919	155	155	171
11	32	531	61.9	72.1	1.40	956	174	174	191
12	19	515	67.3	81.8	2.01	922	158	158	175

TABLE 4

Achievement and Expenditure Means -- Math Projects in Saturated Schools

Grade	Number of Districts	Pupils per District	Pretest	Posttest	Average Mo. Gain	Regular $ Per-pupil	Title I $ Per-pupil	Title I + STEP	Total $ Supplem.
1	52	527	10.8	18.1	1.36	811	97	106	108
2	92	516	15.8	25.3	1.33	829	93	104	123
3	171	518	22.0	32.0	1.41	812	49	54	64
4	170	515	29.6	38.8	1.31	814	49	55	65
5	167	512	37.3	45.7	1.21	815	50	56	66
6	168	512	44.1	51.9	1.13	814	48	54	64
7	4	518	42.0	60.2	2.61	836	63	70	72
8	4	518	51.2	69.0	2.46	836	63	70	72
9	4	519	56.8	72.5	2.26	877	143	143	143
10	1	514	63.0	52.0	-1.82	965	373	373	373
11	1	514	67.0	70.0	.50	965	373	373	373
12	1	514	79.0	81.0	.33	965	373	373	373

The data presented in Tables 1 through 4 are summarized in Table 5 which presents weighted averages of the statistics computed across grade levels. This table shows clearly that Title I and Total Supplementary per-pupil expenditures are substantially higher in unsaturated than in saturated schools although there is no difference in Regular per-pupil expenditures. It is also apparent that gains are greater in unsaturated schools.

TABLE 5

Achievement and Expenditure Means Summarized across Grade Levels

	Reading		Math	
	Saturated	Unsaturated	Saturated	Unsaturated
Average Monthly Gains	1.04	1.42	1.29	1.40
Pupils per School/District	117	124	515	521
Regular $ per Pupil	817	801	817	794
Title I $ per Pupil	76	205	59	156
Title I plus STEP	83	206	65	156
Total Supplementary $	104	257	86	164
Total $ per Pupil	921	1058	903	958

One's immediate first impression from the figures presented in Table 5 is that increased Title I per-pupil expenditures result in greater achievement benefits. Upon closer examination the picture is not nearly so clear. As shown in Figures 1 and 2, for example, those Title I participants in unsaturated schools who show the greatest growth rates generally begin each school year with a somewhat lower pretest status than their counterparts in saturated schools and are not notably superior to them at the end of the year. At the end of the sixth grade

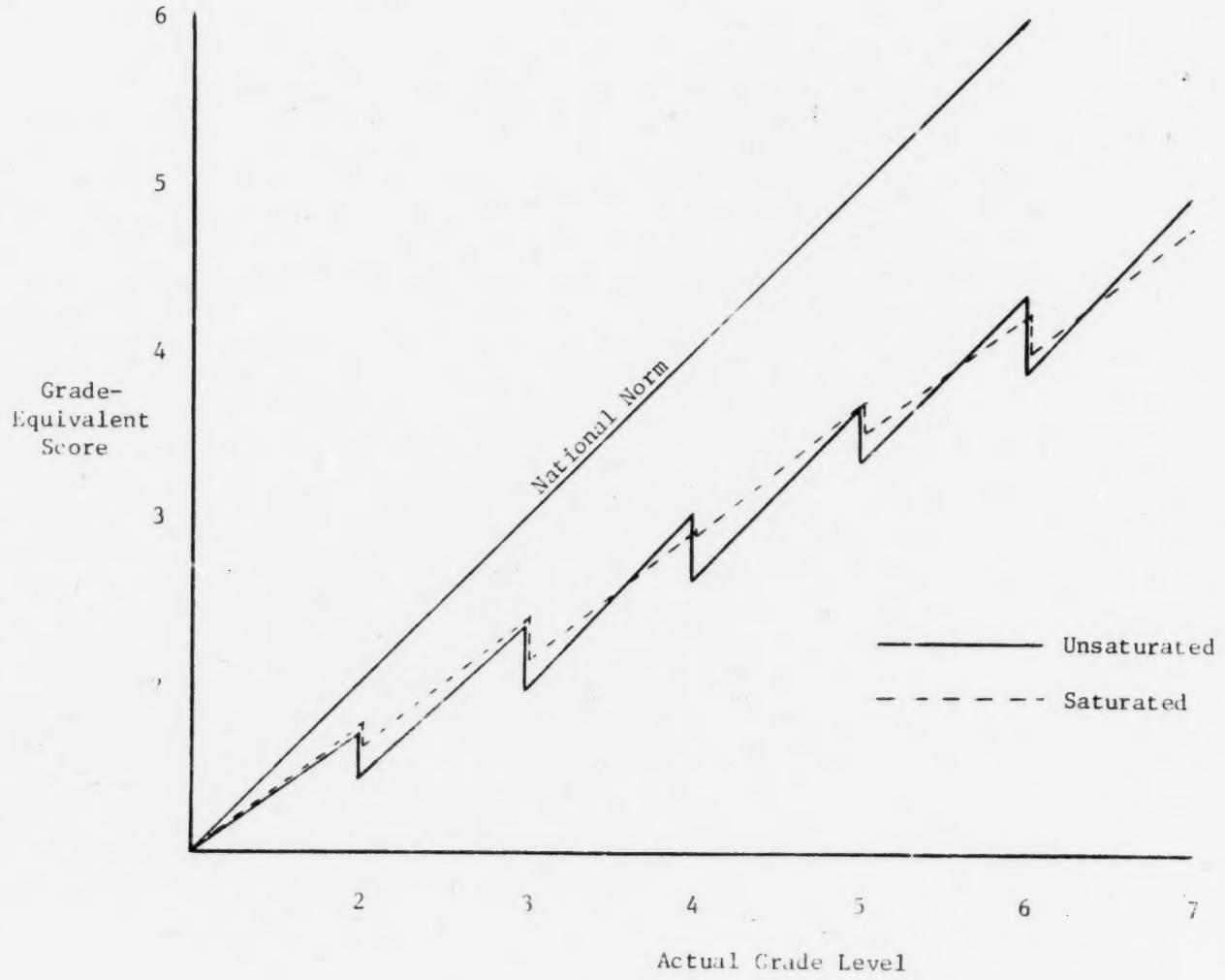

Fig. 1. Reading Growth Rates in Saturated and Unsaturated Schools

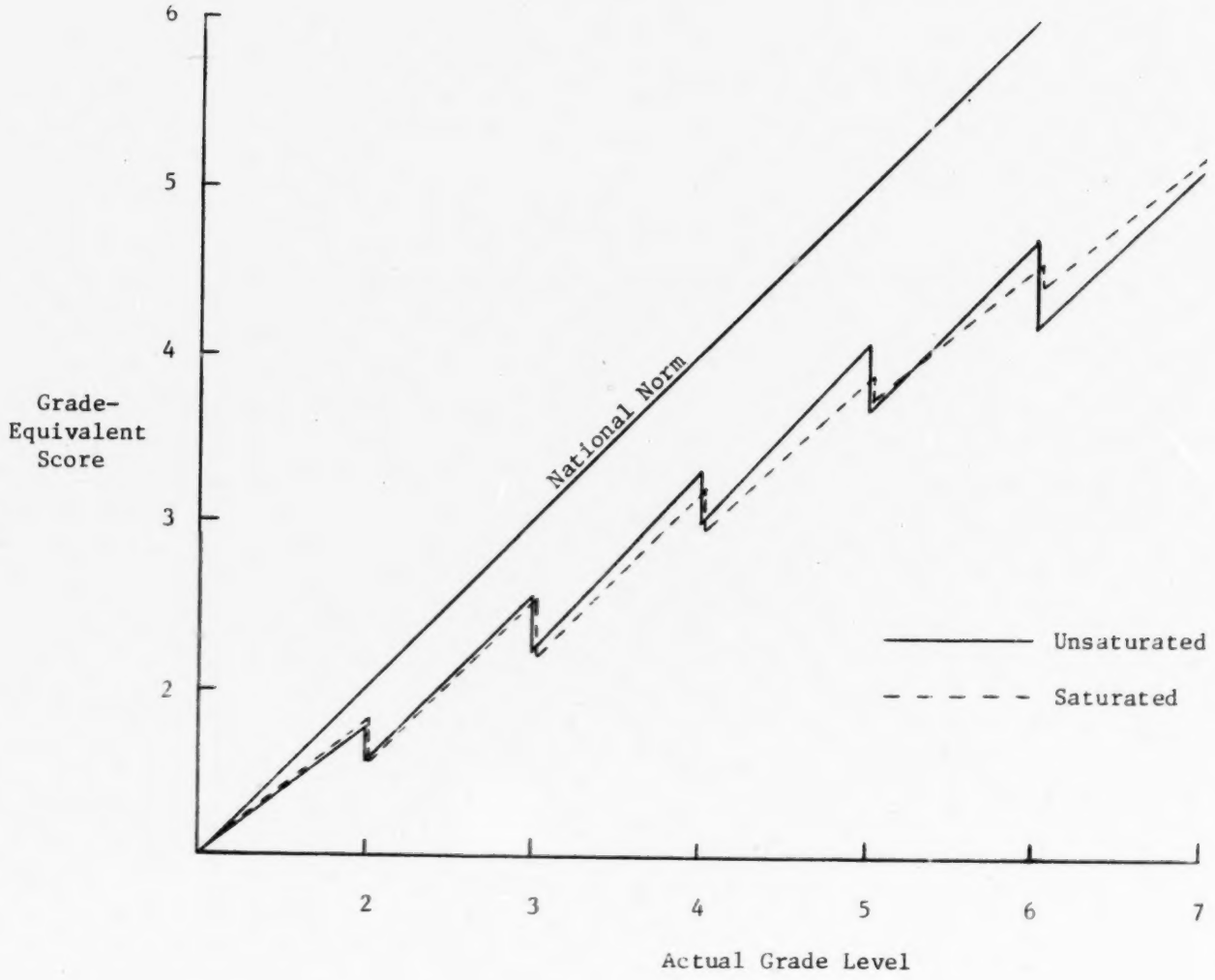

Fig. 2. Mathematics Growth Rates in Saturated and Unsaturated Schools

(the last point at which sample sizes are adequate), all groups are nearly equal and all groups have averaged, since beginning first grade, a growth rate approximately equal to the disadvantaged norm of .7 years growth per year in school (Reading, Unsaturated = .70; Reading, Saturated = .68; Math, Unsaturated = .73; Math, Saturated = .74).

There is some danger in interpreting Figures 1 and 2 as if they represented longitudinal data. They do not -- the data are cross sectional and each year's growth is represented by a different sample of pupils. For this reason it is not strictly legitimate to talk about losses over the summer. We do not know how those children represented by each pretest point on the figures scored at posttest time the year before. Still, it seems reasonable to assume that many, and perhaps most, of the children served by Title I in the sixth grade this year were also served last year in the fifth grade and in earlier grades and years as well. Until data are acquired over at least a 12-month interval (ideally from posttest one year to posttest the following year), questions of this sort must remain unanswered.

Intercorrelations among the ten variables considered in this study were also calculated, although variable 1 (Saturated vs. Unsaturated schools) was not meaningful within groups. (Variable 10, Total Per-pupil Expenditures, has also been eliminated from most presentations since it is completely redundant with the sum of variables 6, Regular Per-pupil Expenditures, and 9, Total Supplementary Per-pupil Expenditures). Visual examination of the 48 correlation matrices revealed some grade-level differences but none which would contraindicate pooling the correlations-across grade levels within groups.

Before considering the matrices obtained by pooling across grade level, some mention should be made of the differences which were observed between grades. The most interesting of these is the relationship between grade level and the magnitude of correlations between pre- and posttest scores. This relationship is almost perfect for grades one through six (rho = 1.0 for reading in saturated and unsaturated schools and for math in saturated schools; rho = .94 for math in unsaturated schools).

When pooled across subject matters and types of school*, the pre-posttest correlations are as follows:

First grade	r = .259
Second grade	r = .390
Third grade	r = .584
Fourth grade	r = .642
Fifth grade	r = .718
Sixth grade	r = .841

It should also be remembered that these correlations are based on a restricted range of talent (disadvantaged children) and would presumably be higher if based on a representative sample of California school children. The implications are clear: whatever differences existed in project expenditures or treatments had very little impact on the participating children -- at least at the higher grade levels. Post-treatment performance is highly predictable from pre-treatment status.

Other notable between-grade differences were: (a) rather high correlations (.65 in unsaturated and .52 in saturated schools) between math gains and number of project participants per school or district for the sixth grade only (the corresponding correlations were near zero at other grade levels); (b) moderately high correlations (.35, .32, .36) between pretest scores and all categories of supplementary expenditures only in sixth grade reading projects in saturated schools whereas these correlations tended to be near zero elsewhere; and (c) generally greater deviations of grades 1, and 7 through 12, correlations from the weighted averages presented in Tables 6 through 9 than was the case in grades 2 through 6.

The first two of these three between-grade differences do not seem to be interpretable in the light of the data in hand. The third

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* This is not a strictly legitimate procedure here since some of the same pupils will be represented in more than one of the pooled correlations, hence they will not be independent. On the other hand, the procedure is useful for illustrative purposes.

difference is most likely attributable to smaller (and probably less representative) sample sizes.

Despite these observed differences, correlations were pooled across grade levels using Fisher's z transformation (McNemar, 1969, p. 158). The matrices of pooled correlations are presented in Tables 6 through 9.

TABLE 6

Pooled Correlations -- Reading Projects in Unsaturated Schools

	Pre-test 2	Post-test 3	Aver. Mo. Gain 4	No. of Pupils 5	Reg. $ 6	Title I $ 7	Title I + STEP 8
2	1.000						
3	.646	1.000					
4	-.258	.521	1.000				
5	-.025	.042	.058	1.000			
6	.101	.060	-.049	.027	1.000		
7	-.053	.008	.061	-.042	-.073	1.000	
8	-.052	.006	.057	-.043	-.071	.999	1.000
9*	-.056	-.023	.034	-.057	-.059	.811	.815

* Variable 9 is Total Supplementary Per-pupil Expenditures in Tables 6-9.

TABLE 7

Pooled Correlations -- Reading Projects in Saturated Schools

	Pre-test 2	Post-test 3	Aver. Mo. Gain 4	No. of Pupils 5	Reg. $ 6	Title I $ 7	Title I + STEP 8
2	1.000						
3	.666	1.000					
4	-.109	.647	1.000				
5	.116	.146	.083	1.000			
6	.059	.045	-.012	-.027	1.000		
7	.079	.226	.272	.030	.265	1.000	
8	.102	.197	.258	.013	.277	.988	1.000
9	.096	.237	.273	-.006	.448	.856	.858

TABLE 8

Pooled Correlations -- Math Projects in Unsaturated Schools

	Pre-test 2	Post-test 3	Aver. Mo. Gain 4	No. of Pupils 5	Reg. $ 6	Title I $ 7	Title I + STEP 8
2	1.000						
3	.665	1.000					
4	-.185	.590	1.000				
5	.129	.153	.072	1.000			
6	.019	-.013	-.048	.028	1.000		
7	-.023	.007	.032	.027	-.069	1.000	
8	-.027	.002	.029	.024	-.064	1.000	1.000
9	-.011	-.017	-.008	.018	-.034	.847	.848

TABLE 9

Pooled Correlations -- Math Projects in Saturated Schools

	Pre-test 2	Post-test 3	Aver. Mo. Gain 4	No. of Pupils 5	Reg. $ 6	Title I $ 7	Title I + STEP 8
2	1.000						
3	.601	1.000					
4	-.070	.660	1.000				
5	.203	.103	-.027	1.000			
6	.030	.023	-.026	-.007	1.000		
7	.328	.212	-.015	-.024	.241	1.000	
8	.312	.200	-.022	.042	.258	.981	1.000
9	.325	.216	-.012	.025	.430	.921	.931

In all four matrices, the highest correlations are those interrelating the three supplementary expenditure variables -- a not surprising finding since Title I expenditures dominate all three. Next in magnitude are the correlations of pretest with posttest and of posttest with average monthly

gain. With these exceptions, all other correlations were near zero for both reading and math in unsaturated schools. In the saturated schools there were correlations of the order of .2 or .3 between supplementary expenditure variables and achievement measures. Again, for reasons that are not clear, the achievement-expenditure correlations involved pre- and posttest scores for math but posttest and gain scores for reading. The latter relationship is compatible with normal expectations while the former implies that funds were spent in inverse proportion to the needs of participating pupils.

Wargo et al. (1972) correctly pointed out that since Title I funds supplement regular per-pupil expenditures, their impact may be obscured by the large variations known to exist in regular expenditures. The need to account for this relationship is particularly evident in California, where published regular per-pupil expenditures by school district ranged from $353.26 to $3,017.08 in FY 1971. Fortunately the technique of partial correlation affords a convenient method for examining the impact of Title I expenditures on achievement with the effects of variations in regular expenditures statistically removed.

A second problem which can be dealt with at least to some extent by means of partial correlations concerns the use of gain scores as criterion variables. This issue has been widely debated in recent years (Cronbach & Furby, 1970; O'Connor, 1972). As those concerned with this issue point out, change scores are unreliable. Many recommendations for alternatives have been made including the use of posttest scores only, various types of residual change scores, covariance analysis, etc. While the data available to this study do not lend themselves to all of these approaches, it was possible to "partial out" the effects of pretest score differences from the relationships between gain scores and expenditure variables. It would also have been possible to partial pretest score differences out of posttest score relationships but, as Shaycoft (1967, Appendix H-2) has shown, these two approaches are mathematically equivalent and will yield identical results.

Tables 10 through 13 present correlations between gains and supplementary per-pupil expenditures with regular per-pupil expenditures and pretest scores partialled out. These statistics are presented separately by grade level within each of the four analytic groups. Sums or weighted averages (computed using Fisher's z transformation) are presented at the bottom of each table.

Tables 10 through 13 present, for the first time in this report, statistics on the number of schools or districts for which some data were available and the number of schools or districts for which complete data were available. As can be seen, the attrition rates were quite high in general and about twice as great for the saturated schools (72% for both reading and math) as for the unsaturated districts (30% for reading and 31% for math).

The preponderance of the losses was due to the inclusion of only pre- or only posttest data which precluded the computation of gain scores. Occasional losses occurred because the interval between tests was not specified, because no regular per-pupil expenditure data were available, and, in two instances, because the data were obviously erroneous (Title I per-pupil expenditures of $12,000 and $32,000 respectively).

The difference in attrition rates of saturated schools as opposed to unsaturated districts is attributed to the fact that multi-school districts would "survive" even when schools within them were lost.

There do not appear to be any systematic effects due to grade level although where samples are small, and probably non-representative (grades 1, and 7 through 12), deviations from the weighted averages are sometimes substantial.

The weighted average partial correlations included in Tables 10 through 13 are presented again in Table 14 to facilitate between-group comparisons. Also included in Table 14 are the corresponding multiple correlations. Both the partial and the multiple correlations are generally low with the largest one (.313) accounting for less than 10%

TABLE 10

Correlations* between Gains and Supplementary Expenditures with Regular Expenditures and Pretest Scores Partialled Out -- Reading in Unsaturated Schools

Grade Level	N	N_R	$r_{47 \cdot 6}$	$r_{49 \cdot 6}$	$r_{47 \cdot 2}$	$r_{47 \cdot 26}$
1	248	204	.066	-.001	.033	.072
2	485	316	.126	.064	.128	.124
3	488	321	-.006	-.008	.021	-.018
4	473	312	-.063	-.024	-.070	-.075
5	464	298	.114	.038	.110	.106
6	443	277	.172	.124	.170	.172
7	54	49	-.071	.054	-.027	-.098
8	51	46	-.083	-.050	-.033	-.080
9	81	77	.127	.066	.133	.143
10	62	61	-.082	.010	-.089	-.108
11	52	51	-.019	.011	-.043	-.124
12	37	36	.039	-.001	.021	-.056
Totals	2938	2048	.060	.031	.057	.046

*N = Number of districts which submitted reports

N_R = Number of districts with complete achievement and cost data

$r_{47 \cdot 6}$ = Correlation between average monthly gains and Title I per-pupil expenditures with regular per-pupil expenditures partialled out

$r_{49 \cdot 6}$ = Correlation between average monthly gains and total supplementary per-pupil expenditures with regular per-pupil expenditures partialled out

$r_{47 \cdot 2}$ = Correlation between average monthly gains and Title I per-pupil expenditures with pretest scores partialled out

$r_{47 \cdot 26}$ = Correlation between average monthly gains and Title I per-pupil expenditures with pretest scores and regular per-pupil expenditures partialled out

TABLE 11

Correlations* between Gains and Supplementary Expenditures with Regular Expenditures and Pretest Scores Partialled Out -- Reading in Saturated Schools

Grade Level	N	N_R	$r_{47.6}$	$r_{49.6}$	$r_{47.2}$	$r_{47.26}$
1	268	44	.117	-.003	.111	.186
2	518	169	.511	.489	.519	.672
3	552	167	.477	.470	.522	.607
4	505	161	.061	.157	.064	.046
5	495	166	.284	.352	.287	.308
6	473	166	.046	.141	-.027	-.002
7	65	5	.305	-.844	.990	.491
8	59	5	.528	-.201	.646	.741
9	96	4	.163	.391	.023	.000
10	77	1	-	-	-	-
11	63	1	-	-	-	-
12	45	1	-	-	-	-
Totals	3216	890	.283	.312	.289	.278

*N = Number of schools which submitted reports

N_R = Number of schools with complete achievement and cost data

$r_{47.6}$ = Correlation between average monthly gains and Title I per-pupil expenditures with regular per-pupil expenditures partialled out

$r_{49.6}$ = Correlation between average monthly gains and total supplementary per-pupil expenditures with regular per-pupil expenditures partialled out

$r_{47.2}$ = Correlation between average monthly gains and Title I per-pupil expenditures with pretest scores partialled out

$r_{47.26}$ = Correlation between average monthly gains and Title I per-pupil expenditures with pretest scores and regular per-pupil expenditures partialled out

TABLE 12

Correlations* between Gains and Supplementary Expenditures with Regular Expenditures and Pretest Scores Partialled Out -- Math in Unsaturated Schools

Grade Level	N	N_R	$r_{47.6}$	$r_{49.6}$	$r_{47.2}$	$r_{47.26}$
1	246	194	-.008	-.110	.034	0.038
2	373	281	.019	-.013	.005	-.004
3	463	292	.009	-.073	.012	-.011
4	459	289	.007	-.022	-.001	-.007
5	445	278	.040	.024	.042	.035
6	435	267	.085	.070	.111	.106
7	50	46	-.025	-.078	-.064	-.068
8	44	40	-.212	-.237	-.206	-.210
9	69	65	.072	.091	.102	.073
10	47	46	.218	.265	.186	.191
11	33	32	.020	-.033	.022	-.005
12	20	19	.276	.225	.221	.257
Totals	2684	1849	.029	-.011	.033	.030

*N = Number of districts which submitted reports

N_R = Number of districts with complete achievement and cost data

$r_{47.6}$ = Correlation between average monthly gains and Title I per-pupil expenditures with regular per-pupil expenditures partialled out

$r_{49.6}$ = Correlation between average monthly gains and total supplementary per-pupil expenditures with regular per-pupil expenditures partialled out

$r_{47.2}$ = Correlation between average monthly gains and Title I per-pupil expenditures with pretest scores partialled out

$r_{47.26}$ = Correlation between average monthly gains and Title I per-pupil expenditures with pretest scores and regular per-pupil expenditures partialled out

TABLE 13

Correlations* between Gains and Supplementary Expenditures with Regular Expenditures and Pretest Scores Partialled Out -- Math in Saturated Schools

Grade Level	N	N_R	$r_{47 \cdot 6}$	$r_{49 \cdot 6}$	$r_{47 \cdot 2}$	$r_{47 \cdot 26}$
1	267	52	.487	.497	.652	.663
2	405	92	-.110	-.101	-.055	-.063
3	496	171	-.052	-.086	-.017	-.015
4	491	170	.023	-.003	-.049	.004
5	476	167	-.018	.024	-.040	-.029
6	435	138	-.089	-.047	-.099	-.107
7	59	4	.481	.172	.613	.999
8	53	4	.602	.311	.907	.999
9	83	4	.967	.967	-.990	-.999
10	56	1	-	-	-	-
11	40	1	-	-	-	-
12	25	1	-	-	-	-
Totals	2886	805	-.001	.003	.002	.004

*N = Number of schools which submitted reports

N_R = Number of schools with complete achievement and cost data

$r_{47.6}$ = Correlation between average monthly gains and Title I per-pupil expenditures with regular per-pupil expenditures partialled out

$r_{49.6}$ = Correlation between average monthly gains and total supplementary per-pupil expenditures with regular per-pupil expenditures partialled out

$r_{47.2}$ = Correlation between average monthly gains and Title I per-pupil expenditures with pretest scores partialled out

$r_{47.26}$ = Correlation between average monthly gains and Title I per-pupil expenditures with pretest scores and regular per-pupil expenditures partialled out

TABLE 14

Partial and Multiple Correlations* Involving
Achievement and Expenditure Variables

	$\frac{r_{47\cdot6}}{r_{4\cdot76}}$	$\frac{r_{49\cdot6}}{r_{4\cdot96}}$	$\frac{r_{47\cdot2}}{r_{4\cdot72}}$	$\frac{r_{47\cdot26}}{r_{4\cdot726}}$
Reading - Unsat.	$\frac{.060}{.076}$	$\frac{.031}{.058}$	$\frac{.057}{.262}$	$\frac{.035}{.263}$
Reading - Sat.	$\frac{.283}{.286}$	$\frac{.312}{.312}$	$\frac{.289}{.302}$	$\frac{.278}{.313}$
Math - Unsat.	$\frac{.029}{.056}$	$\frac{-.011}{.049}$	$\frac{.003}{.187}$	$\frac{.030}{.192}$
Math - Sat.	$\frac{-.001}{.029}$	$\frac{.003}{-.013}$	$\frac{.002}{.071}$	$\frac{.004}{.075}$

* See Table 13 for key to partial correlations. Corresponding multiples have average monthly gains as the criterion with other variables as predictors.

of the criterion variance. All of the correlations are undoubtedly depressed by the inadequacies of the data which were discussed earlier. How high they might rise if better data were obtained cannot, unfortunately, even be estimated from information currently available.

If there is a positive relationship between expenditures and gains, it is apparent from the data in Table 14 only for reading projects in saturated schools. While four other multiple correlations lie in the range from .19 to .26, they are primarily due to relationships between pretest scores and gains, not expenditures and gains.

As mentioned in the Introduction of this report, the so-called critical mass issue was to be investigated as one aspect of the cost-effectiveness study. Toward this end the computer was instructed to print out scatter diagrams showing the relationships between average

monthly gains and (a) regular per-pupil expenditures, (b) Title I per-pupil expenditures, (c) Title I plus STEP per-pupil expenditures, and (d) total per-pupil expenditures. These scatter diagrams were obtained at each grade level within each of the four analytical groups.

The 192 resulting scatter diagrams were individually examined in an attempt to identify some point on the expenditure continua where greater than average gains significantly outnumbered below average gains. It was clear from these examinations that no meaningful cut-off points existed for any of the expenditure variables and no further analyses were undertaken. While this decision resulted in an unsatisfactory amount of negative evidence regarding the critical mass issue, the only alternative was to conduct a complex series of Chi Square (or equivalent) analyses, collapsing each of the 192 scatter diagrams in a succession of different ways. The amount of time and effort required for this task could not be justified in the light of other priorities.

A decision was also made not to include all 192 scatter diagrams in this report. On the following pages, however, five examples are presented. The first, Figure 3, is for first grade math in saturated schools and shows a positive relationship between average monthly gains and Title I per-pupil expenditure ($r = .478$). The relationship appears to be more or less constant over the entire range of both variables. Figure 4 shows another positive ($r = .458$) relationship between the same two variables -- this time for third grade reading in saturated schools. In this case, however, the correlation seems more directly due to the poor performance of children at schools reporting zero expenditures.

The scatter shown in Figure 5 is more typical than those in Figures 3 and 4 which were specifically selected because they depicted two of the highest correlations obtained. The Figure 5 diagram shows a near zero ($r = -.026$) relationship between average monthly gains and total per-pupil expenditures for third grade reading projects in unsaturated schools. It was selected because it represents the largest number of schools at any within-group grade level ($N = 321$).

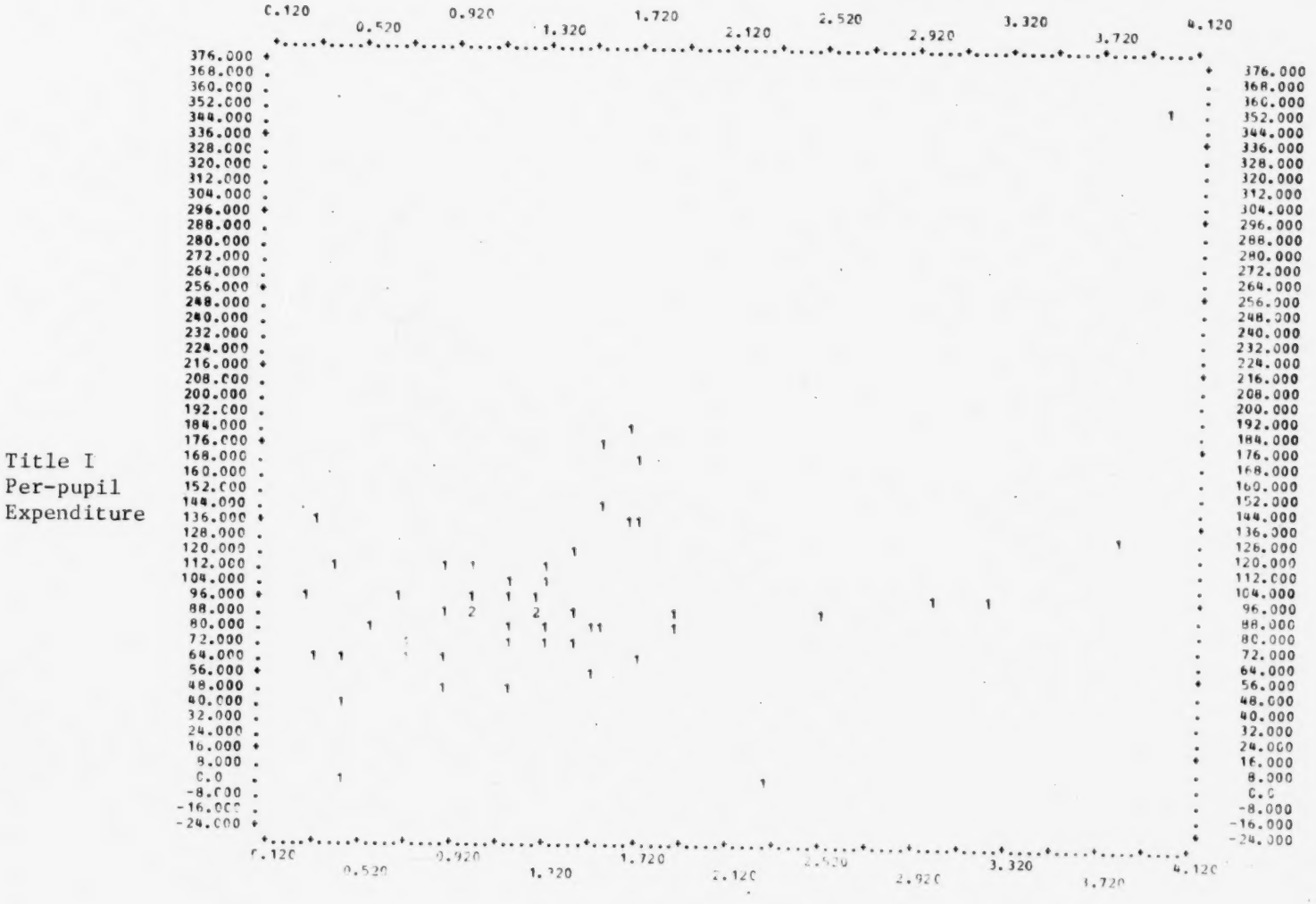

Fig. 3. Cost-benefit Scatter Diagram -- First Grade Mathematics in Saturated Schools

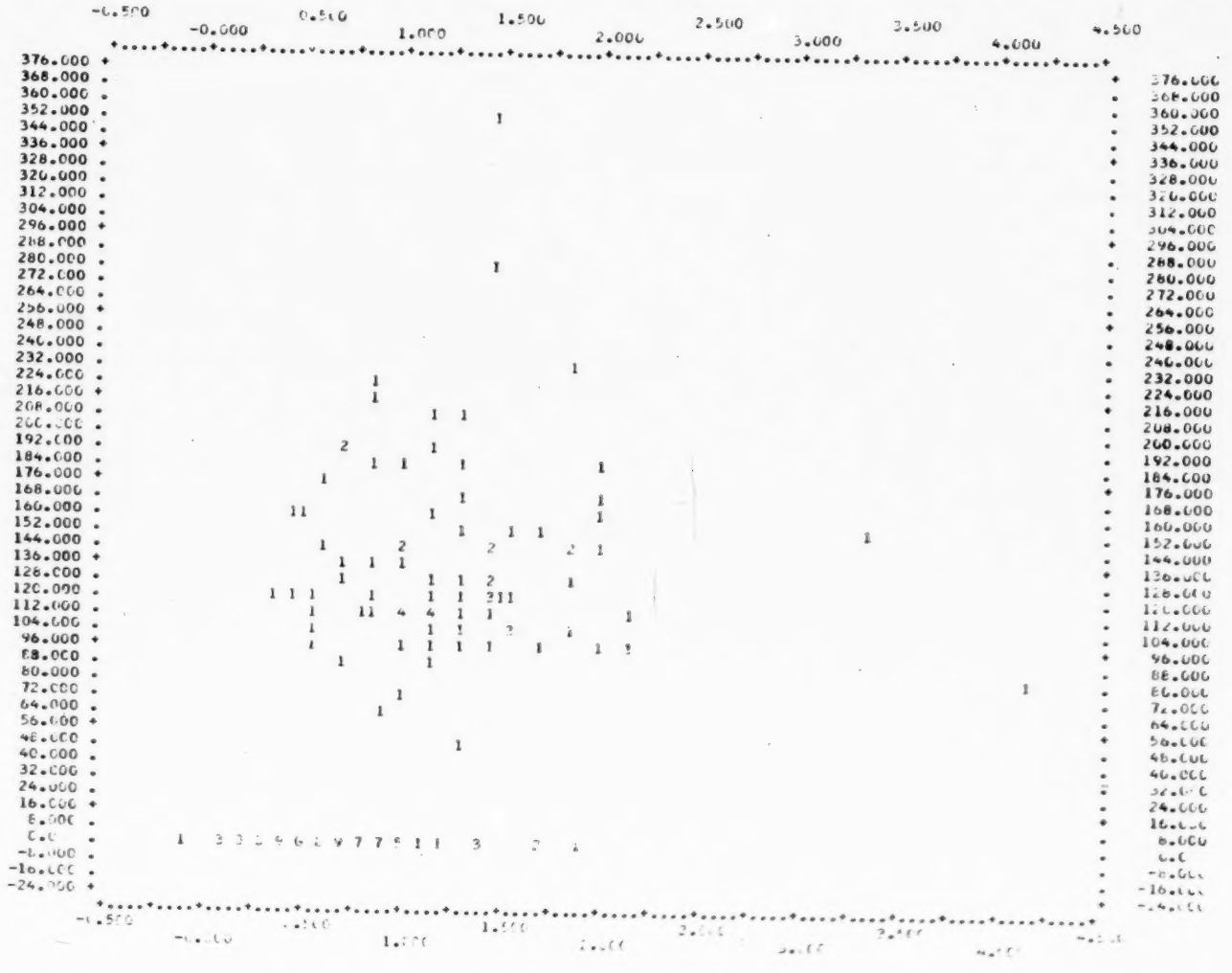

Fig. 4. Cost-benefit Scatter Diagram -- Third Grade Reading in Saturated Schools

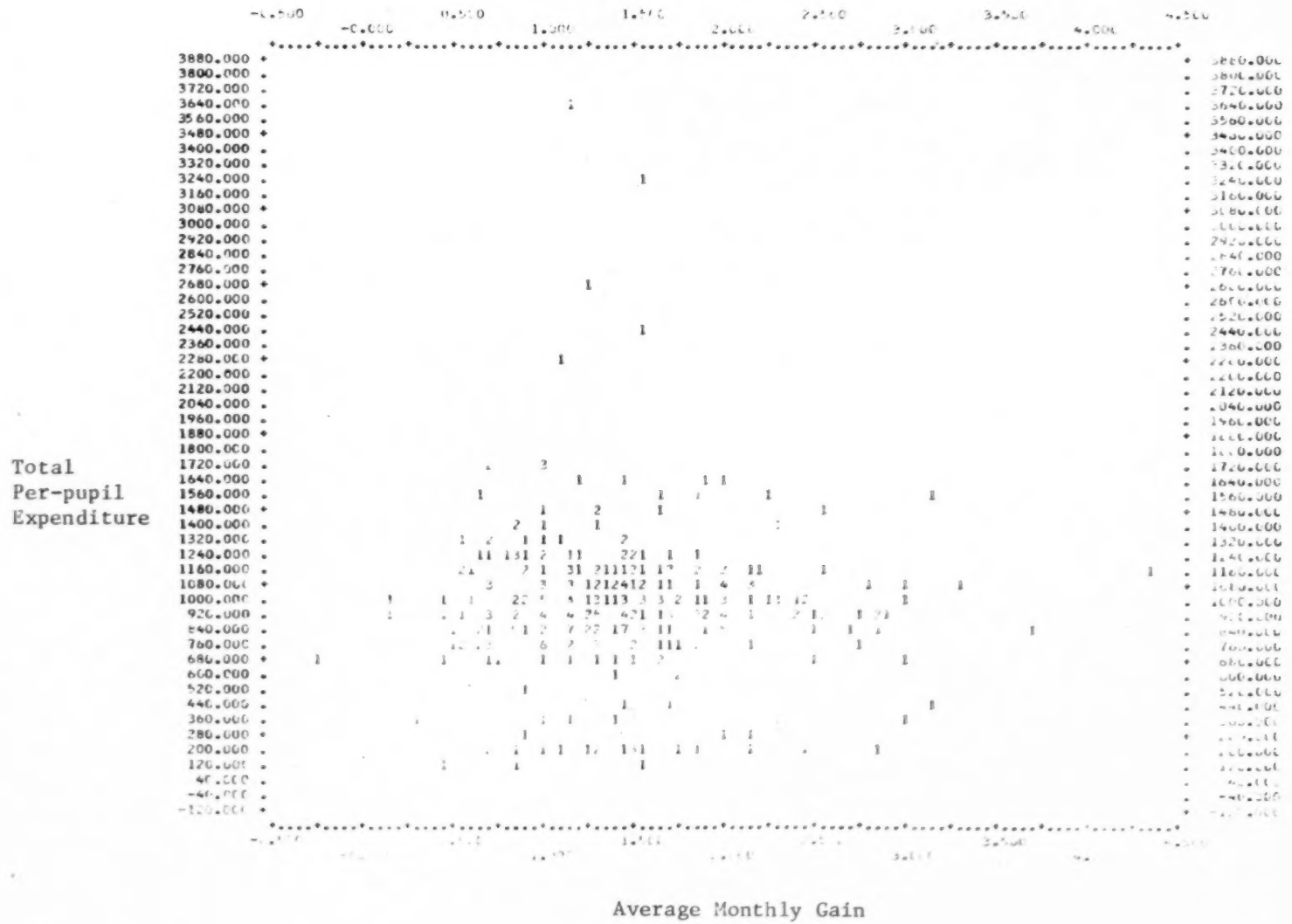

Fig. 5. Cost-benefit Scatter Diagram -- Third Grade Reading in Unsaturated Schools

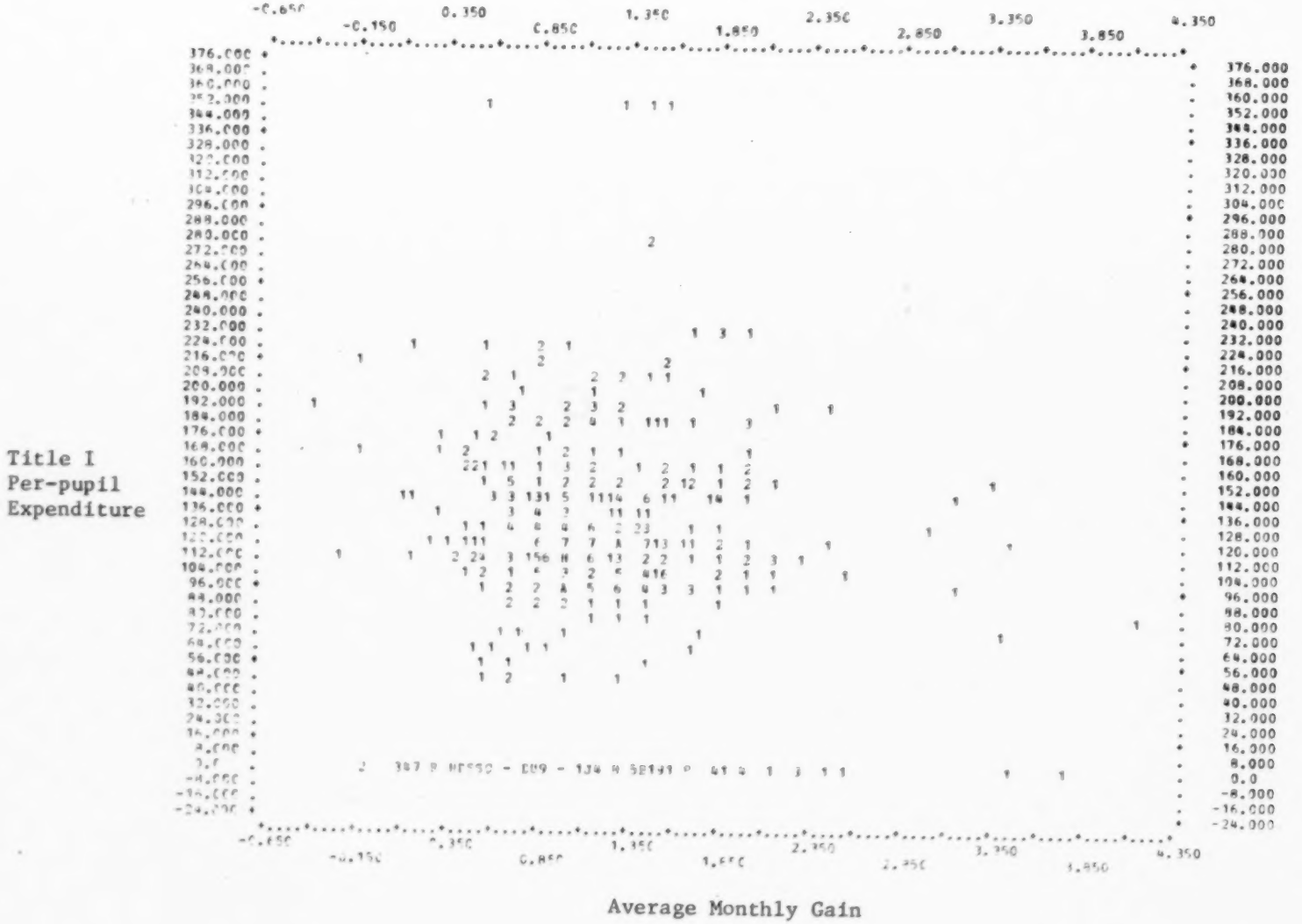

Fig. 6. Cost-benefit Scatter Diagram -- Reading, Grades 2 through 6, in Saturated Schools

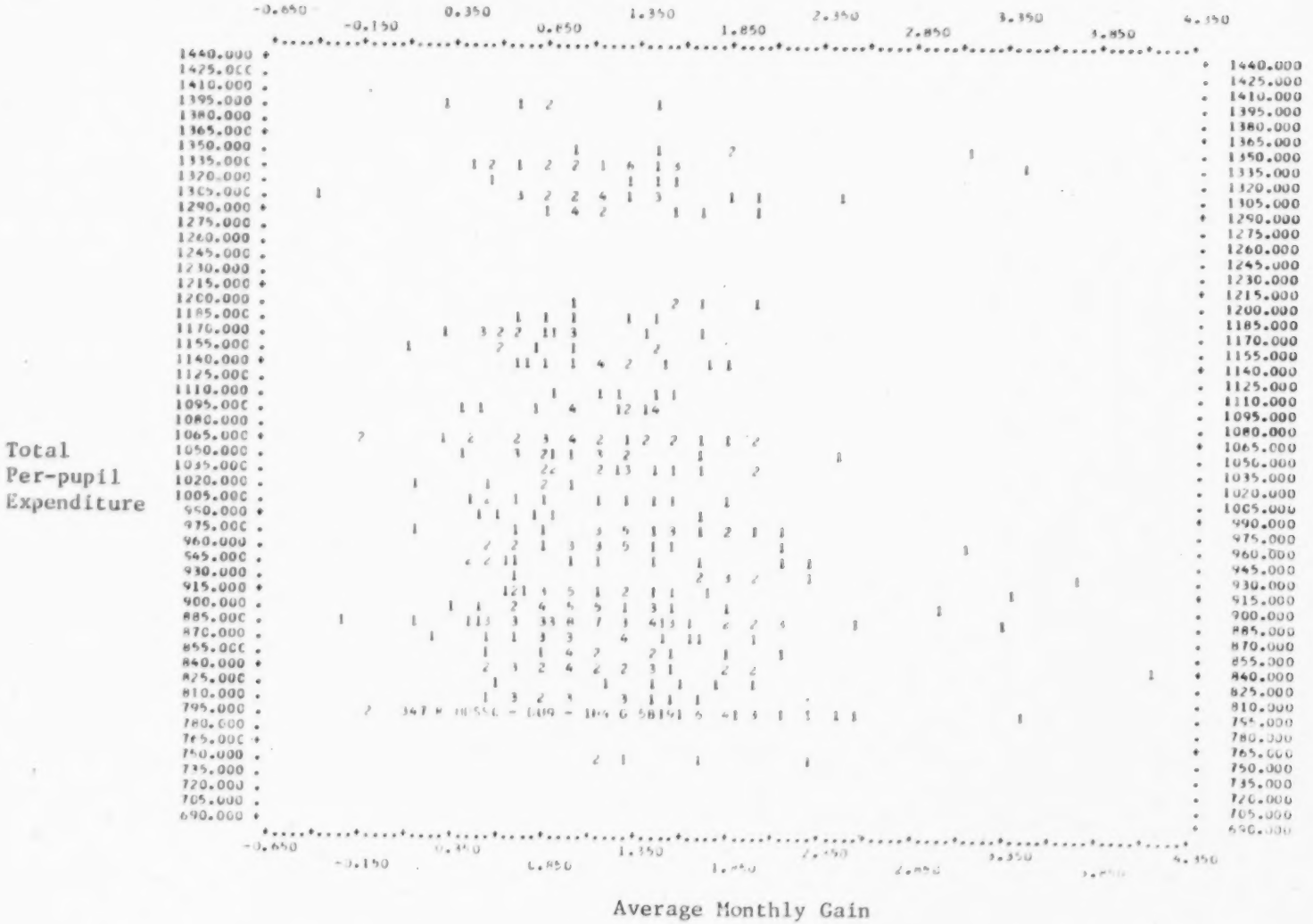

Fig. 7. Cost-benefit Scatter Diagram -- Reading, Grades 2 through 6, in Saturated Schools

Figures 7 and 8 were prepared after the study had been completed and present data pooled across grades two through six. They show respectively the relationships between (a) reading achievement gains in saturated schools and Title I per-pupil expenditures (r = .274) and (b) reading achievement gains in saturated schools and total per-pupil expenditures (r = .205). [Note: Letters of the alphabet represent cell frequencies from 10 (a = 10) to 35 (z = 35) and -'s represent frequencies from 36-41 (there is no discrimination within this range)].

DISCUSSION AND CONCLUSIONS

The analyses described in the preceding chapter of this report do not provide much support for the existence of a relationship between achievement gains and per-pupil expenditures -- either regular or supplemental. For reading programs in saturated schools there did appear to be a cost-benefit relationship involving Title I expenditures which accounted for approximately 10% of the achievement variance. This relationship, as was pointed out earlier, might be significantly stronger if better measures were obtained of the dependent and independent variables. On the other hand, no cost-benefit relationships were identified involving mathematics programs or reading programs in unsaturated schools.

No evidence was found supporting the existence of a "critical mass."

Children in unsaturated schools were found to make greater gains in both reading and math than did their counterparts in saturated schools. Since supplementary (particularly Title I) expenditures were greater in unsaturated schools, it appeared, at first, that a relationship might be found between expenditures and gains. Within the unsaturated schools, however, no such relationship could be found even though there was a wide range of expenditures which substantially overlapped that of saturated schools. Furthermore, there was some evidence suggesting that the greater gains made by children in unsaturated schools during the school year were offset by greater losses during the summer.

With respect to this latter point, none of the data analyzed covered the same children for more than a single school year. Inferences made regarding summer losses were based on the fact that pretest grade-equivalent scores were consistently at or below the disadvantaged norm (.7 x grade level) while gains each school year exceeded month for month. At no grade level were Title I participants in unsaturated schools significantly better off than their peers in saturated schools.

Clearly this evidence and the inferences drawn from it are important for both educational policy and educational practice. The evidence is

only circumstantial, however, and needs to be verified by means of longitudinal data collected over at least a 12-month period. Collection of such data would appear to be a high priority activity in view of the great importance of policy decisions in this area.

The California Follow-up study found quite a high correlation between costs and benefits in the sample of Title I projects it examined. It should be pointed out that comparable results would have been obtained here had data from saturated and unsaturated schools been combined as presumably they were in that study. Even if the within-group correlations had been zero for both saturated and unsaturated schools, a fairly strong (but spurious) relationship would result from pooling the two groups since one was substantially higher than the other in terms of both cost and achievement variables. Figure 8 illustrates this phenomenon.

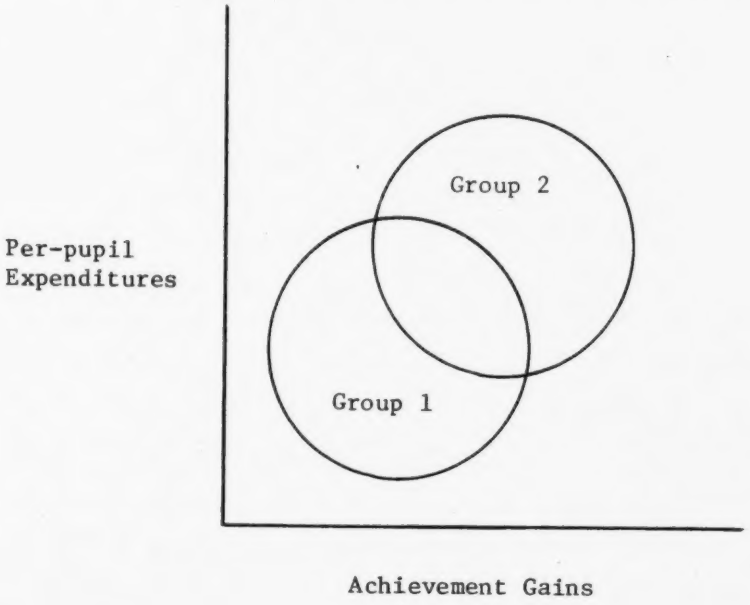

Fig. 8. Production of a Spurious Correlation by the Pooling of Two Non-homogeneous Groups within Each of which the Correlation is Zero.

The fact that unsaturated school districts report both higher gains and higher expenditures than saturated schools suggests, in the absence of a significant cost-benefit correlation, that the difference between

types of schools is produced by some other influence. Socioeconomic status and racial mixture represent two plausible explanatory hypotheses, but the data in hand do not lend themselves to investigation of this issue.

In addition to the zero-order correlations calculated between gain scores and the various supplementary expenditure categories, partial correlations were calculated to remove the effects of variations in regular per-pupil expenditures and pretest grade-equivalent status. This procedure raised the gain-Title I expenditure correlations very slightly for reading projects in saturated schools but had no noticeable effect in the other groups analyzed. Apparently the impact of Title I expenditures is largely independent of regular per-pupil expenditures. This finding was somewhat surprising in view of the seemingly sound expectation expressed by Wargo et al. (1972) that the effects of Title I expenditures would be at least partially determined by the level of regular per-pupil expenditures.

Multiple correlations were also calculated using achievement gains as the criterion with pretest scores and various expenditure categories as predictors. These multiple correlations were not much different from the corresponding zero-order correlations between gains and Title I expenditures except for reading and math projects in unsaturated schools where substantial increases were observed. These increases were attributable to a combination of substantial negative correlations between pretest and gain scores and slightly negative correlations between pretest scores and Title I expenditures. While this finding was not of particular significance, it directed attention to the rather high positive correlation ($r = .328$) between pretest scores and Title I expenditures for math projects in saturated schools. This correlation signified a district tendency to spend the least money on the children with the greatest educational need and vice versa.

As was discussed elsewhere in this report, the critical mass issue was addressed by visual examination of 192 scatter diagrams showing each school's (or district's) position on a two-dimensional plot defined by average monthly gain and per-pupil expenditure (regular, Title I, Title I plus STEP, and total per-pupil expenditures were plotted separately

against gain scores). No evidence could be found suggesting that there was a specific point on any of the expenditure continua above which greater than average gains outnumbered below average gains. Positive relationships between gains and expenditures were identified under some conditions (see above) but there never appeared to be the kind of discontinuity implied by the critical mass concept.

Many states, including California, have accepted the critical mass concept and have mandated specific minimum per-pupil expenditures. Funds appropriated for Title I programs, however, have been grossly inadequate to serve all eligible children at levels equal to or above the critical mass criterion. As a result, many eligible children have not been served (California served approximately 40% of the eligible children during FY 72). Failure to serve the other eligible children could become a significant moral and political issue should the critical mass concept fail to stand up under scrutiny.

In conclusion it may be said that this study produced some evidence supporting the existence of a positive relationship between supplementary per-pupil expenditures and achievement gains. This relationship was observed under only one of four treatment conditions, but the characteristics of the data may have obscured similar relationships under the other treatment conditions just as it must be assumed they attenuated the size of the observed correlation.

On the other hand, correlations between pre- and posttest scores were quite high under all treatment conditions and increased in magnitude as a function of grade level. Post-treatment median grade-equivalent scores maintained much the same relative standing from school to school and district to district as the corresponding pre-treatment scores -- a finding which implies that all projects were approximately equally effective in producing achievement benefits. It would also tend to suggest that treatment impact had not been great, as even small differences among highly effective programs would tend to be too disruptive of the status quo for the correlations between pre- and posttest scores to be as high as were observed.

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